Assessing Remedial Dredging Effects and Effectiveness: Examples from New Bedford Harbor

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Introduction

- Currently, there is a growing national debate about dredging contaminated sediments, including:
  - Effects on human health and the environment
  - Effectiveness of remedial activities
- Questions and concerns relative to assessing remedial dredging effects and effectiveness can be addressed in the design and implementation of operational and long-term monitoring programs
  - Examples provided from the New Bedford Harbor (NBH) Superfund Site

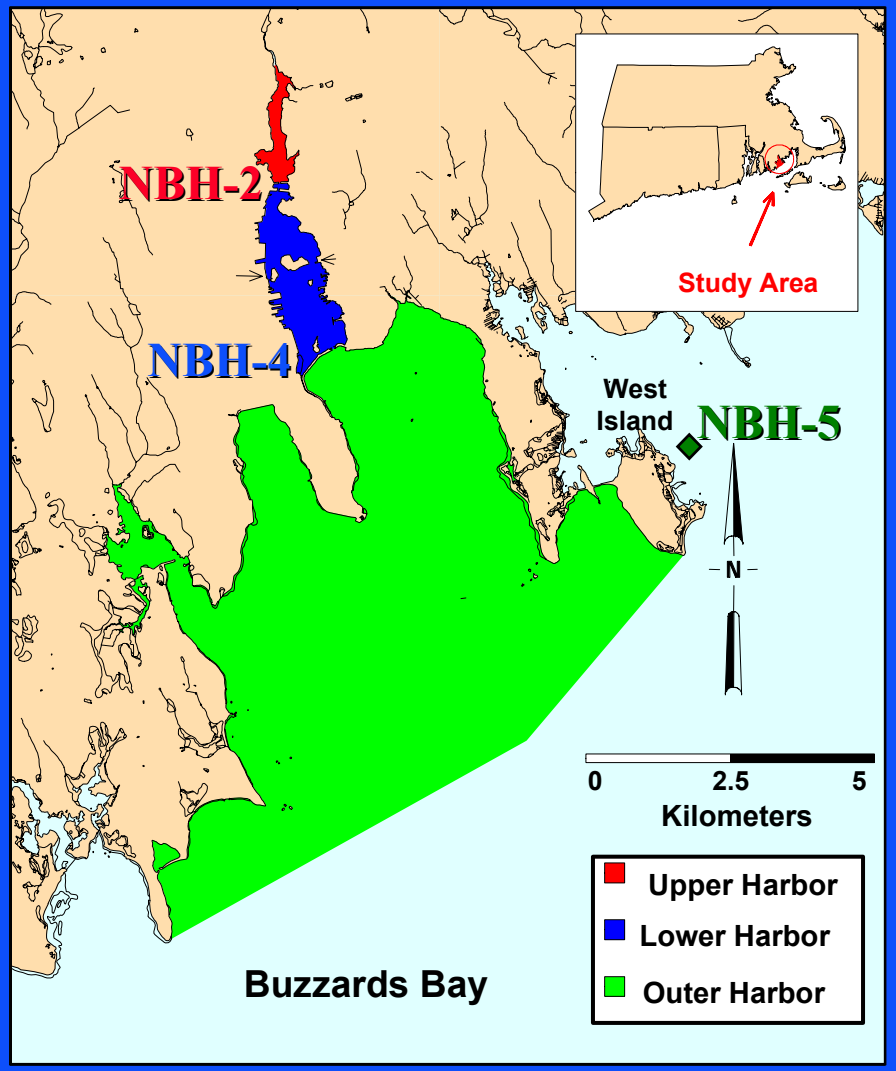
Remedial Dredging: Questions & Concerns

- Remedial Effects:
  - Does dredging increase toxicity and bioaccumulation?
  - Does dredging contaminate previously clean areas?
- Remedial Effectiveness:
  - Can the environmental benefits of dredging be rigorously documented?

- Addressed in NBH by:
  - Pilot Study
  - Hot Spot Remediation
  - Long-Term Monitoring Program

New Bedford Harbor Superfund Site

- Superfund Site due to high sediment PCB concentrations:
  - Upper Harbor (~200 a., red):
    - Almost entire area to be remediated
  - Lower Harbor (~800 a., blue):
    - Depositional areas only
  - Outer Harbor (~17,000 a., green):
    - Isolated areas to be remediated

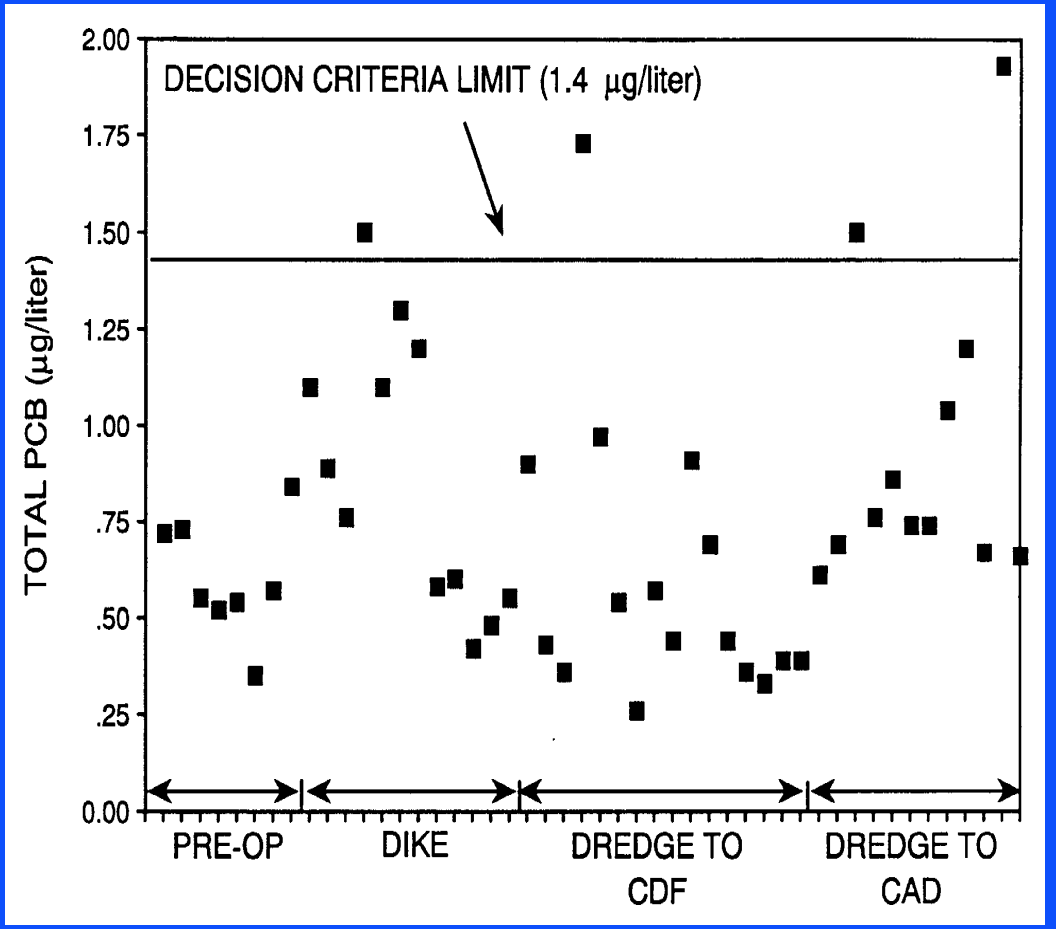


Remedial Effects: Pilot Study (1988-89)

- Goal:
  - Determine if dredging was feasible from an environmental and engineering perspective
- Concerns:
  - Will dredging increase toxicity and bioaccumulation?
  - Can ecological effects be limited while dredging alternatives are evaluated?
- Approach:
  - Develop site-specific decision criteria (chemical & biological)
  - Real-time monitoring feedback loop linked to specific dredging operations to limit potential negative effects

Remedial Effects: Pilot Study

- Results & Conclusions:
  - With "real-time" monitoring feedback loop, observed daily effects were minimized and directly linked to causes
  - Natural disturbances (e.g., storms, wind) produced effects equivalent to remedial operations

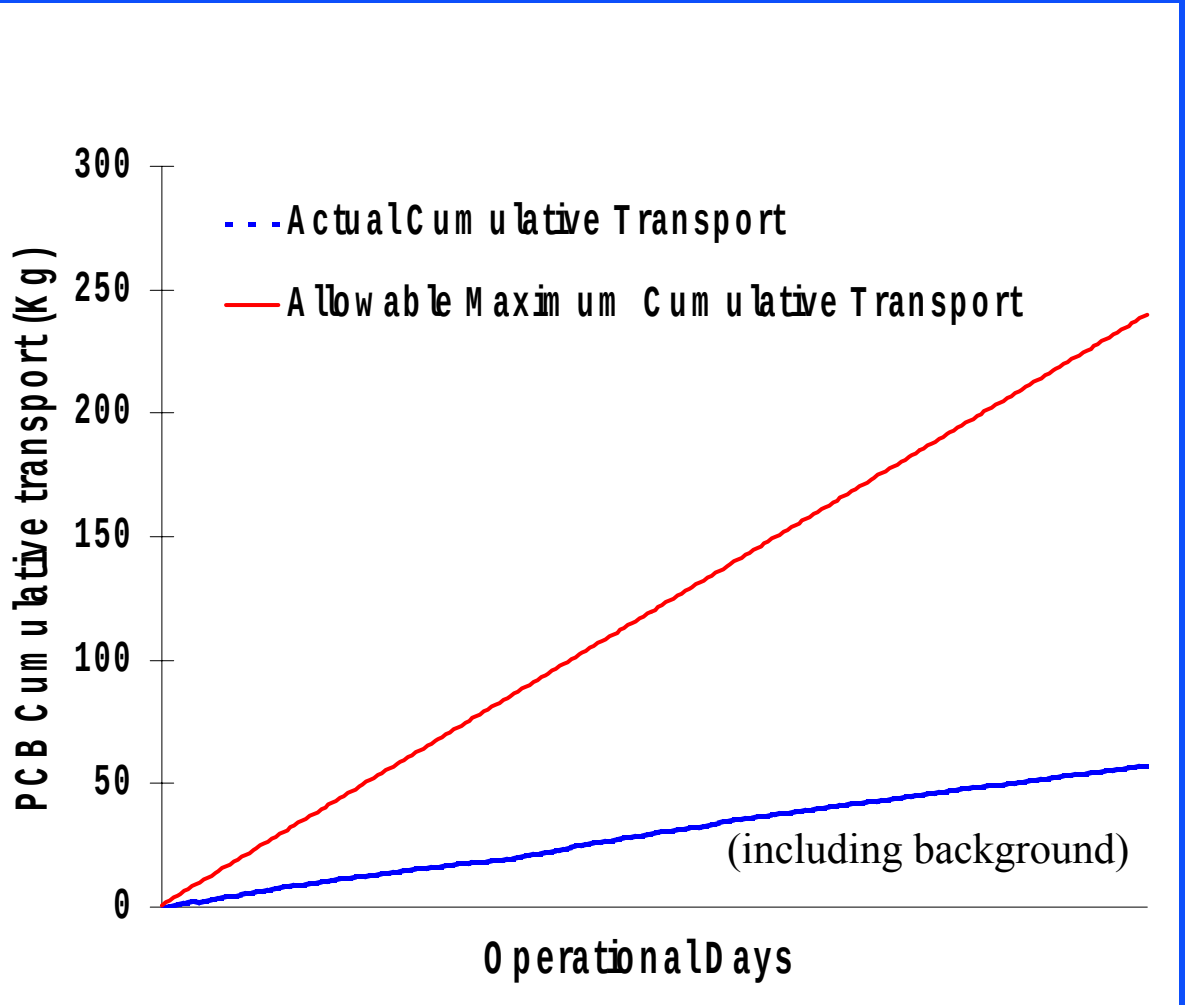


Remedial Effects: "Hot Spot" (1994-95)

- Goals:
  - Mass removal of sediments with [PCB] > 4000 ppm
  - Limit transport of PCBs to lower harbor
- Concern:
  - Will dredging contaminate clean areas in the lower harbor?
- Approach:
  - Established criteria for:
    - Cumulative net PCB transport to the lower harbor
    - Acute and chronic toxicity

Remedial Effects: "Hot Spot" (cont.)

- Results & Conclusions:
  - Net PCB transport well below the decision criteria of 240 kg
  - No significant increase in mean surface sediment concentrations in the lower harbor ('93=8ppm; '95=7ppm)
  - No acute or chronic toxicity attributable to the dredging operation



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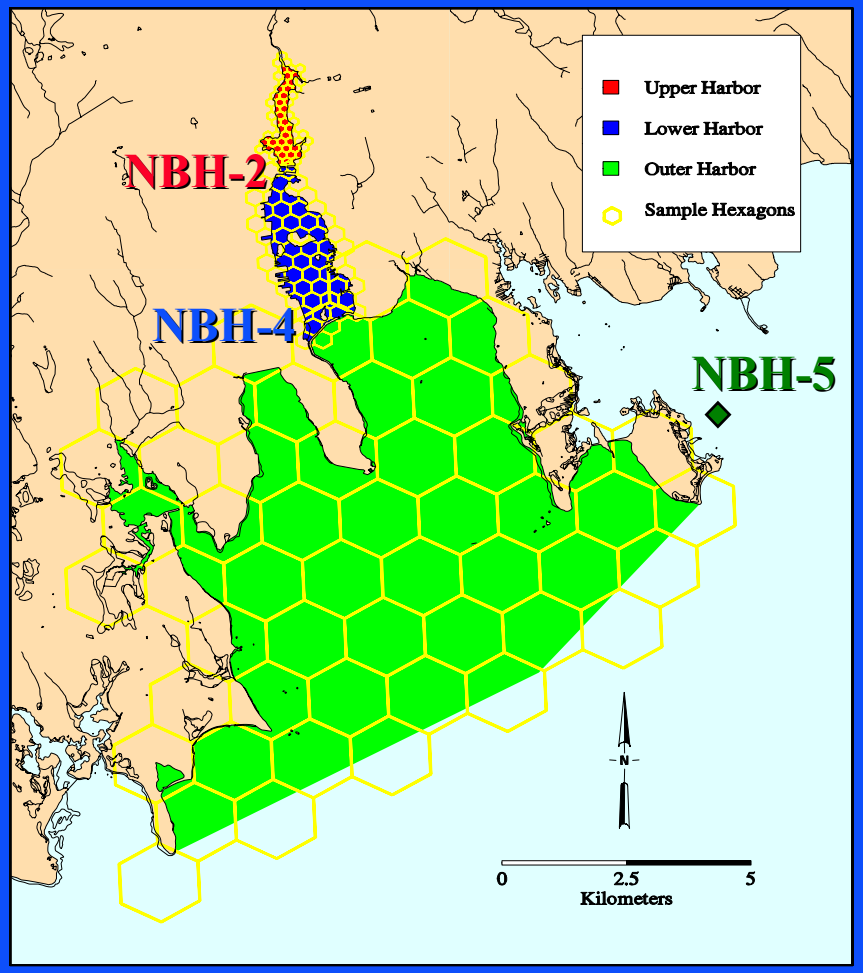
Remedial Effectiveness: Long-Term Monitoring Program (1993 - ??)

- Goal:
  - Assess the effectiveness of all remedial activities
- Concern:
  - Can the environmental benefits of remediation be effectively documented?
- Approach:
  - Measure physical (e.g., grain size), chemical (e.g., PCBs), and biological (e.g., species richness) indicators both spatially and temporally using a statistically rigorous design

Remedial Effectiveness: Long-Term Monitoring Program Design

- Spatial Considerations:
  - Coverage of entire area (72 stations)
  - Probabilistic design
- Temporal Considerations:
  - Before/after each remedial phase (or every 5 years)
- Three collections to date: baseline-1993, post-Hot Spot-1995, pre-upper harbor remediation-1999



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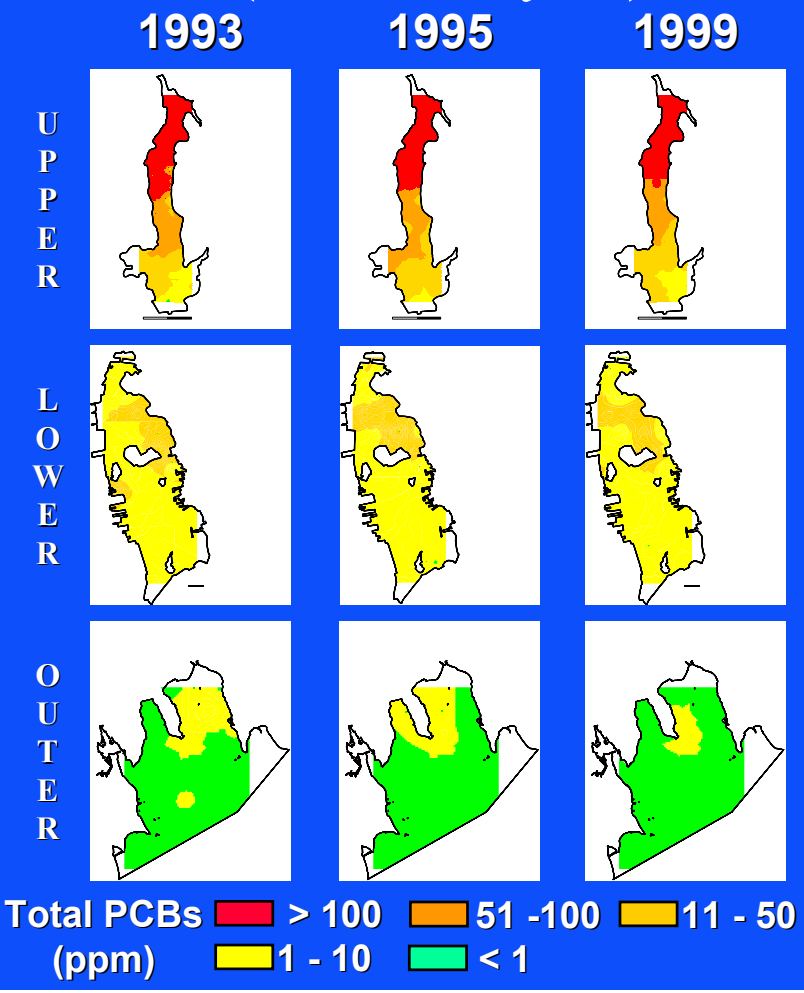
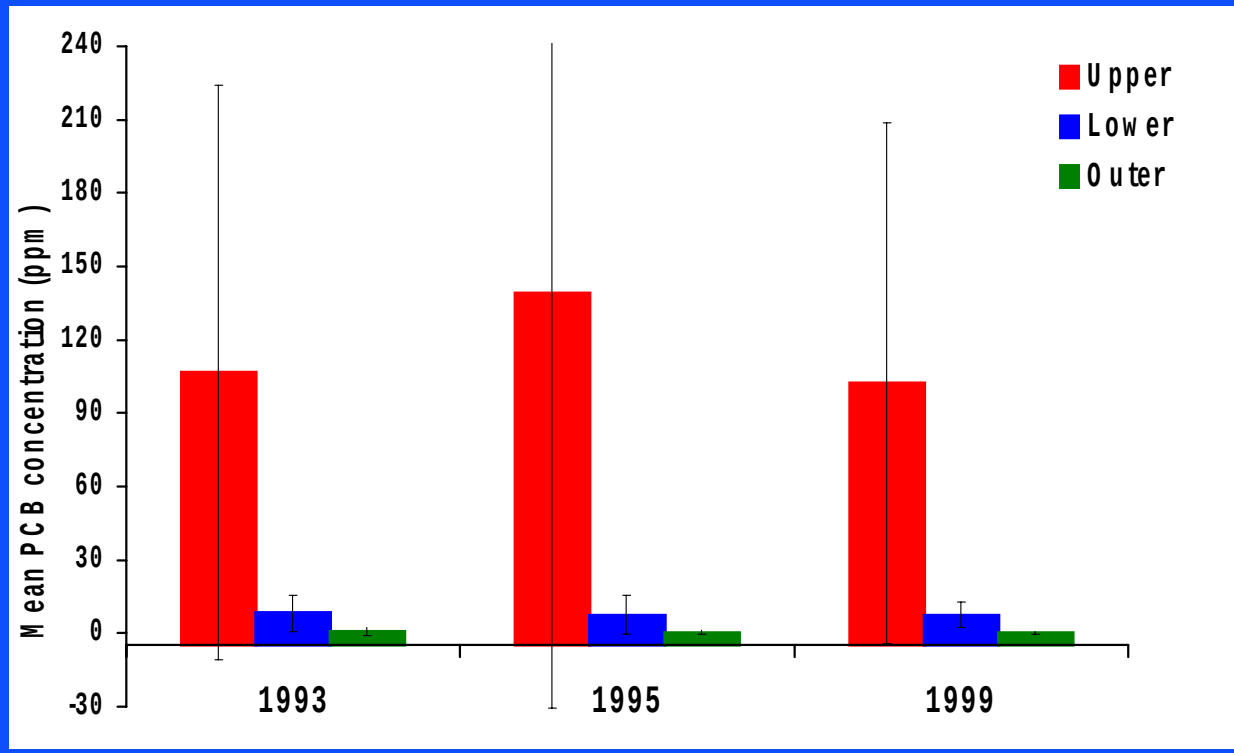
Remedial Effectiveness: Long-Term Monitoring Program Results

Total PCBs (ppm) (GIS Analysis)



Total PCBs (ppm) (Statistical Analysis)



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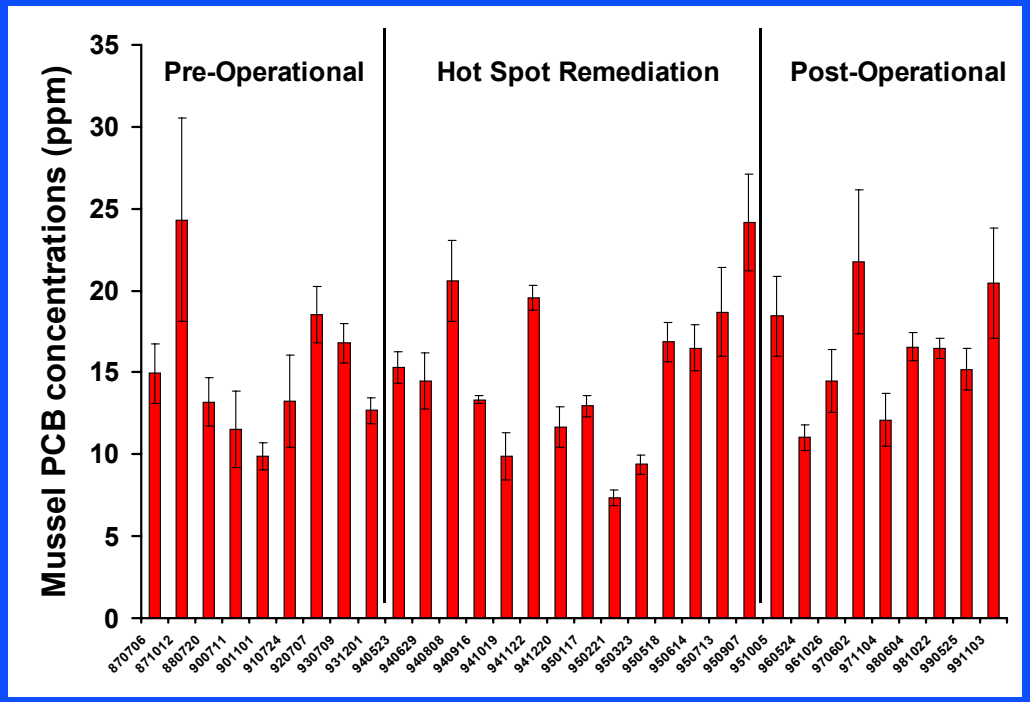
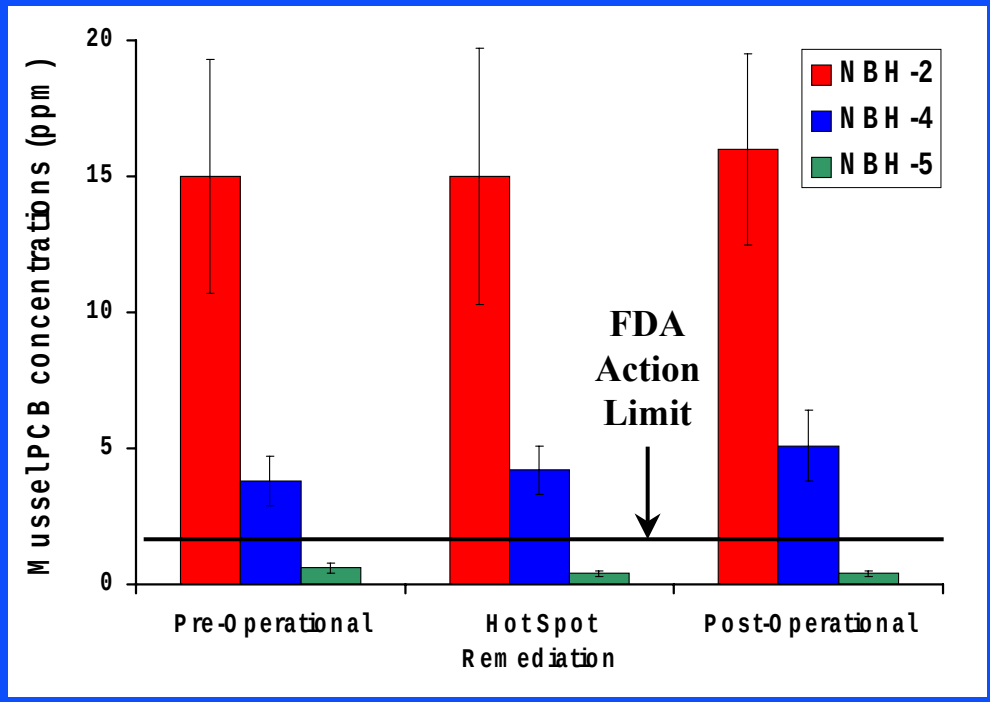
Remedial Effectiveness: Long-Term Monitoring Program Results

Mussel Bioaccumulation After 28-day Deployments (NBH-2)



Mean Mussel Bioaccumulation for Each Operational Phase (NBH-2, -4, -5)



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Remedial Effectiveness: Long-Term Monitoring Program Conclusions

- Spatial Results:
  - Significant differences for some indicators between the three harbor segments (e.g., species richness highest in outer harbor)
- Temporal Results:
  - Indicators changed minimally within a harbor segment (e.g., PCB sediment concentrations)
    - Hot Spot remediation occurred within only a small fraction (~5-acres) of the total upper harbor surface area (~200 acres)
- As exposures decrease with complete upper harbor remediation, monitoring will be able to assess remedial effectiveness by quantifying changes in program indicators

Summary

- Remedial Effects:
  - Does dredging increase toxicity and bioaccumulation?
  - Does dredging contaminate previously clean areas?
- Remedial Effectiveness:
  - Can environmental benefits of dredging be adequately documented?

- Addressed in NBH by:
  - Implementing a real-time feedback loop between operations and effects
  - Monitoring to limit net PCB transport
  - Establishing a statistically rigorous long-term monitoring program